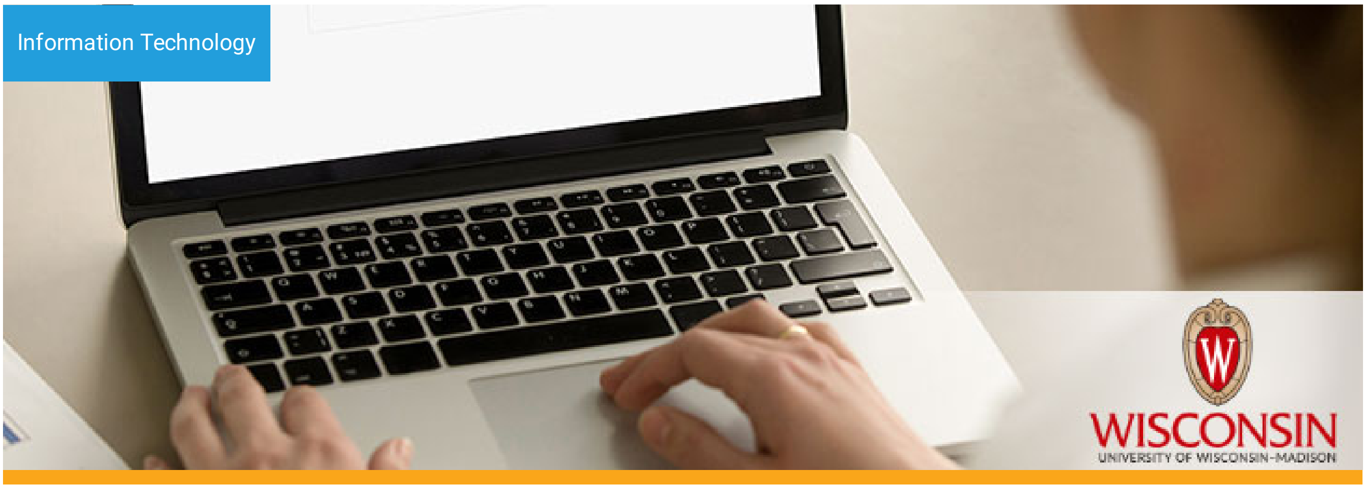

Qubit Measurement System Is Efficient, Scalable

View U.S. Patent No. 9,692,423 in PDF format.

WARF: P140246US01

Inventors: Robert McDermott, Frank Wilhelm-Mauch, Britton Plourde, Maxim Vavilov, Luke Govia, Emily Pritchett

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing new hardware for the scalable measurement of quantum bits.

Overview

In the field of quantum computing, the performance of quantum bits ('qubits') has advanced rapidly in recent years. A truly scalable system requires the ability to rapidly and accurately measure qubits while minimizing costly resources. Conventional measurement methods rely on superconducting amplifiers and heterodyne detectors.

While this approach works well for a small number of readout channels, the various components entail significant overhead. Needed is a new approach that achieves high performance with fewer components and reduced overhead.

The Invention

UW–Madison researchers have developed a novel qubit measurement system based on counting microwave photons. The new system replaces currently used amplification and heterodyne detection techniques.

The measurement proceeds in three stages. First, the state of the qubit is mapped to the microwave photon occupation of a readout cavity. The occupation of the cavity is subsequently detected using the Josephson photomultiplier (JPM), a microwave-frequency photon counter. The measurement leads to a binary digital output: 'click' or 'no click.' The output may be transmitted to a single flux quantum (SFQ) circuit for classical processing.

SFQ circuits, like qubit circuits, are based on superconducting thin films. Therefore, the SFQ processor could be operated on the same cryogenic stage as the quantum circuit to make the system more compact and to reduce measurement latency. Other methods rely on wiring and electrical connections to take measurements and feed them to a room-temperature device for processing, resulting in losses and inefficiencies.

Applications

- Quantum computing hardware

Key Benefits

- Achieves high-fidelity qubit measurement
- Method is efficient, scalable and amenable to further processing.
- Measurement result is amenable to further processing by SFQ digital logic.
- JPM circuit detectors have many advantages
    - Utilize relatively low-bandwidth DC wiring

- More compact
- Interface naturally with SFQ logic circuits
- Help mitigate heat load/footprint caused by system connections
- Support high-fidelity parity measurement for error detection

Stage of Development

The researchers have performed promising simulations and preliminary experiments

Additional Information

For More Information About the Inventors

- Robert McDermott
- Maxim Vavilov

Related Technologies

- WARF reference number P120028US01 describes microwave amplifiers for low-noise readout of qubits and linear cavity resonators.
- WARF reference number P140260US01 describes a system to control superconducting quantum circuits using single flux quantum logic.

Publications

- Govia L.C.G., Pritchett E.J., Xu C., Plourde B.L.T., Vavilov M.G., Wilhelm F.K. and McDermott R. 2014. High-fidelity Qubit Measurement with a Microwave-photon Counter. Phys. Rev. A.

Tech Fields

- Information Technology : Hardware

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842